

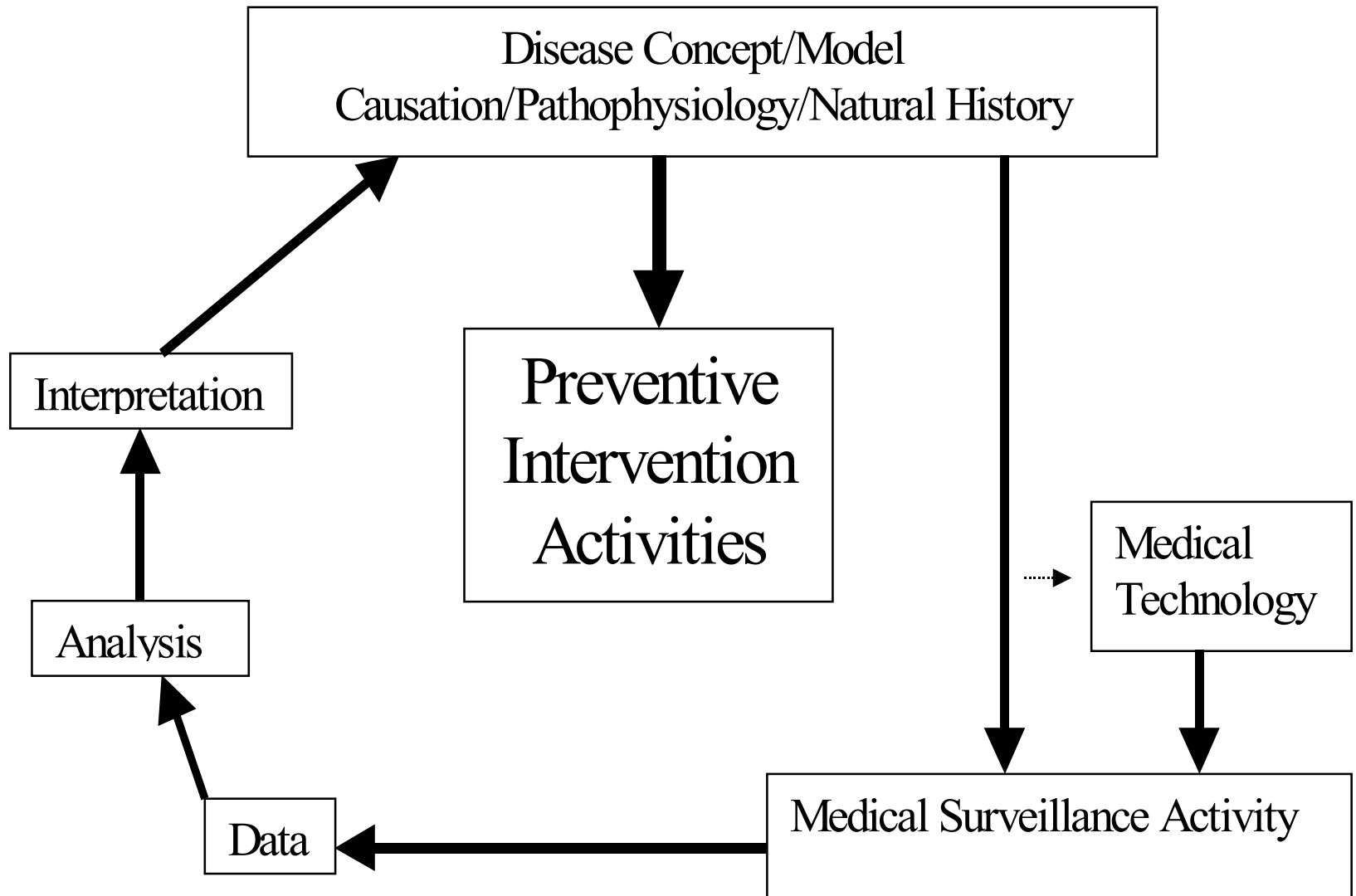
Occupational Medicine Surveillance in the Beryllium Industry

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Participants will be able to

- Present a model of medical surveillance
- Use beryllium as a case study to illustrate the model
- List surveillance modalities for beryllium health effects
- List activities considered relevant to beryllium health effect prevention
- State the effectiveness of these activities



Beryllium Company: 1980

- What were the concepts/models of disease?
 - Chronic beryllium disease a slowly progressive pulmonary fibrosis secondary to cellular immunity mediated inflammation following beryllium inhalation
- What medical technology was available?
 - Medical history, PFTs, x-ray: clinical diagnosis
- What medical surveillance was done?
 - Case Finding
- What data was produced?
 - Qualitative and quantitative exposure histories of cases
- How was the data analyzed?
 - Informal review found frequent history of over-exposure accidents/incidents
- Were disease concepts/models changed?
 - No, since 1960
- How did this translate into preventive intervention activities?
 - Administrative processes to review over exposure incidents, identify origin and prevent recurrence

BeO Ceramics Plant 1992 Survey

- Reported incident of “over-exposure”
 - Beryllium sensitized 50%, others 61%: $p > 0.05$
- High rate operations
 - Machining 14% sensitized: $p < 0.05$
 - Lapping 20% sensitized: $p < 0.05$
- Be air level
 - Machining median BZ = 0.06 micrograms/m³, other areas = 0.03 micrograms/m³, $p < 0.05$
- Reference
 - Kreiss et al AJIM 30: 16-25, 1996

BeO ceramics Plant: 1992

- What were the concepts/models of disease?
 - Slowly progressive pulmonary fibrosis secondary to cellular immunity mediated inflammation following beryllium inhalation
- What medical technology was available?
 - Blood Lymphocyte proliferation test combined with flexible fiber-optic bronchoscopy
- What medical surveillance was done?
 - Plant survey with medical and work history, industrial hygiene data
- What data was produced?
 - Qualitative and quantitative exposure histories on cases and non-cases
- How was the data analyzed, interpreted?
 - Formal statistical analyses showed recollection of over-exposure incidents not associated with risk, machining and lapping were high risk processes, machining had highest air levels
 - Were disease concepts/models changed?
 - Recognition of a greatly expanded spectrum of disease, including mild and sub-clinical “disease”
- How did this translate into preventive intervention activities?
 - High rate areas targeted for engineering for air level reduction

Be Manufacturing Plant: 1993-4

- Reported incident of “over-exposure”
 - Beryllium disease 58%, others 54%: $p > 0.05$
- High rate operations
 - Ceramics 12% sensitized: $p < 0.05$
 - Pebble plant 14% sensitized: $p < 0.05$
- Be air level
 - Cases cumulative exposure 1635 micrograms/m³ days, median 1.3 micrograms/m³; others 1518, 1.0: $p > 0.05$
- Reference
 - Kreiss et al OEM 1997; 54:605-612

Be Manufacturing Plant: 1993-4

- What were the concepts/models of disease?
 - Slowly progressive pulmonary fibrosis secondary to cellular immunity mediated inflammation following beryllium inhalation
- What medical technology was available?
 - Blood Lymphocyte proliferation test combined with flexible fiberoptic bronchoscopy
- What medical surveillance was done?
 - Plant survey with medical and work history, industrial hygiene data
- What data was produced?
 - Qualitative and quantitative exposure histories
- How was the data analyzed, interpreted?
 - Formal statistical analyses showed recollection of over-exposure incidents not associated with risk, ceramics and beryllium metal production salt furnaces were high risk processes but did not have highest air levels, Were disease concepts/models changed?
 - Assumption of air level dose-response was challenged
- How did this translate into preventive intervention activities?
 - High rate areas targeted for engineering for air level reduction

Be Manufacturing Plant: 1997

- High rate operation
 - 1993-1994 Pebble plant 14% sensitized
 - 1997 Pebble plant 6/35 (17%) sensitized among persons with less than 3 years BWI employment, 3/5 of persons in first year of BWI employment
- Unpublished data

Be Manufacturing Plant: 1997

- What were the concepts/models of disease?
 - Slowly progressive pulmonary fibrosis secondary to cellular immunity mediated inflammation following beryllium inhalation
- What medical technology was available?
 - Blood Lymphocyte proliferation test combined with flexible fiber-optic bronchoscopy
- What medical surveillance was done?
 - BLPT and bronchoscopy on “pebbles/oxide” group
- What data was produced?
 - BLPT positive prevalence
- How was the data analyzed, interpreted?
 - Comparison to rates of sensitization in longer term workers
- Were disease concepts/models changed?
 - Evidence of sensitization in first months of work increased sense of urgency. Also, need to protect workers while engineering improvements are made.
- How did this translate into preventive intervention activities?
 - Full time respirator use introduced for any entry into the pebbles-oxide area

Be Ceramics Plant: 1998

- High rate operations: sensitization
 - Lapping: Long term 21%, Short term 25%
 - Forming: Long term 16%, Short term 14%
 - Machining: Long term 18%, Short term 6%
- Be air level
 - Mean, cumulative and peak exposure comparisons not statistically significant in short or long term workers
- Beryllium disease latency
 - Sensitization prevalence peaks 6 months
 - Disease prevalence rises years after several years
- Reference
 - Henneberger et al Int Arch Occ Env Health (2001) 74:167-176

BeO Ceramics Plant: 1998

- What were the concepts/models of disease?
 - Early sensitization followed by slowly progressive pulmonary fibrosis secondary to cellular immunity mediated inflammation following beryllium inhalation
 - What medical technology was available? Unchanged
- What medical surveillance was done?
 - Plant survey with medical and work history, industrial hygiene data; Close work observation
- What data was produced?
 - Qualitative and quantitative exposure histories
- How was the data analyzed, interpreted?
 - Formal statistical analyses showed improvement with engineering but overall risk not lowered. Skin exposure to beryllium not controlled
 - Were disease concepts/models changed?
 - Hypothesis of sensitization via skin added to hypothesis of sensitization via lungs. Confirmation of early sensitization. Engineering to reduce air levels in high risk areas not sufficient
 - How did this translate into preventive intervention activities?
 - Reduction of skin exposure introduced. Respirator use increased. Migration control increased. New employee protection emphasis

Preventive Model

1980

2001

Clean and shipshape

Scheduled
decontamination

Systematic
improvement

Respirator

Elevated levels,
probable accident

Elevated levels
possible

Skin

Not stressed

Exposure prevention

Company Supplied
Clothing

Not stressed

Exposure reduction

Source migration

Engineering stressed

Engineering and work
practices stressed

Area out-migration

Not stressed

Systematic reduction

Site

Systematic control

Detail improvements

New, reassigned
employees

Beryllium orientation

Beryllium orientation
with new concepts and
enhanced training

Medical Surveillance Objectives 2001

- Demonstrate degree of efficacy of current preventive model
- Supply data to distinguish between hypotheses on the dose-response issue
 - Particle size/number
 - Sensitization via skin
 - Susceptibility factors
 - Particle chemistry

ELMORE through 7/23/01

Hire Group	Survey		Hired Prior New Emp. Program		Hired After New Emp. Program	
	Pos./Total	%	Pos./Total	%	Pos./Total	%
Pre-work			0/44	0	5/212	2
0-4 Month	1/45	2	0/42	0	2/168	1
4-8 Month	3/26	12	5/62	8	2/149	1
8-14 Month	1/29	3	3/76	4	3/67	4
14-26 Month	6/103	6	0/57	0	0/3	0
26 Month-5 Yrs	7/75	9	8/132	6		
5-10 Years	0/13	0	0/27	0		
10-20 Years	17/238	7	6/110	5		
20-30 Years	7/76	9	4/98	4		
30+ Years	6/125	5	4/82	5		

TUCSON through 7/23/01

Hire Group	Survey		Hired Prior New Emp. Program		Hired After New Emp. Program	
	Pos./Total	%	Pos./Total	%	Pos./Total	%
Pre-work					1/62	2
0-4 Month	0/5	0			0/69	0
4-8 Month	3/16	19			1/52	2
8-14 Month	1/23	4			0/27	0
14-26 Month	2/20	10			0/5	0
26 Month-5 Yrs	0/11	0	0/35	0		
5-10 Years	1/14	7	1/13	8		
10-20 Years	5/66	8	2/59	3		
20-30 Years	0/3	0	0/4	0		
30+ Years	0/1	0	0/2	0		

Ongoing BLPT Testing: 2001

- What were the concepts/models of disease?
 - Early sensitization followed by slowly progressive pulmonary fibrosis secondary to cellular immunity mediated inflammation following beryllium inhalation
 - What medical technology was available?
 - Unchanged
- What medical surveillance was done?
 - BLPT testing prior to work, at 3, 6, 12, and 24 months and every 2 years
- What data was produced?
 - BLPT incidence on new and prior hire cohorts, and investigation of positives
- How was the data analyzed, interpreted?
 - Arrayed to compare new hires with survey prevalence data and prior hires
- Were disease concepts/models changed?
 - No, Problem of too many hypotheses
- How did this translate into preventive intervention activities?
 - Reinforces current directions

Medical Surveillance Activity 2001

- Demonstrate degree of efficacy of current preventive model
- Supply data to distinguish between hypotheses on the dose-response issue
 - Particle size/number
 - Sensitization via skin
 - Susceptibility factors
 - Particle chemistry
- Process in place, three plants
- Critical need: Four hypotheses need to compete in one analysis
 - Data collected
 - Design stage
 - Material collected
 - Design stage

Participants are able to

- Present a model of medical surveillance
- Use beryllium as a case study to illustrate the model
- List surveillance modalities for beryllium health effects
- List activities considered relevant to beryllium health effect prevention
- State the effectiveness of these activities